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ABSTRACT

A study investigated attempts to influence student-teachers' interactive cognitions by means of specially designed video materials that were detailed illustrations of educational theories. It was hypothesized that student-teachers, having worked through these video materials, would be inclined to used the theoretical key elements in their thinking processes during their own interactive teaching. It was also hypothesized that, for this group, the degree to which these key elements would be cognitively used would be higher compared to a group that only received a verbal explanation of the educational theories. In the design, a no-treatment group was included to obtain baseline data. Student teachers' thought processes were investigated by means of stimulated recall. Results suggest that the student-teachers who worked through the video materials used the elements of the educational theories most frequently in their interactive thinking. Eight tables and figures are included in the report. (Author/JMK)

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THE EFFECTS OF VIDEO MATERIALS
ON STUDENT-TEACHERS' COGNITIONS DURING
THEIR INTERACTIVE TEACHING

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Abstract

In this study it was tried to influence student-teachers' interactive cognitions by means of specially designed video materials. These materials were detailed illustrations of educational theories. It was hypothesized that student-teachers, having worked through these video materials, would be inclined to use the theoretical key elements in their thinking processes during their own interactive teaching. Moreover, it was hypothesized that for this group the degree to which these key elements would be cognitively used would be higher compared to a group which only got a verbal explanation of the educational theories. In the design a no-treatment group was included to obtain baseline data. The thought processes were investigated by means of stimulated recall. Results suggested that the student-teachers who worked through the video materials used the elements of the educational theories most frequently in their interactive thinking.

INTRODUCTION

The origin of the project reported in this paper lies in the concern about the function of educational theory in teacher education and the way in which the functionality of this theory can be measured and enhanced.

The main objective of this study is to determine whether it is possible to bring student-teachers (in the last year of their training) to a level where they would "use" elements from educational theories in their own thinking processes during their interactive teaching. It was hypothesized that this would be possible if the student-teachers studied educational theories with the help of specially designed video materials, containing real-life classroom episodes in which the educational theories were seen "in operation".

A second objective of the study is to make a comparison between the cognitions of student-teachers who have worked through these video materials and student-teachers who are taught educational theories in the traditional (purely verbal) way only.

THEORETICAL FRAMEWORK

Function of educational theory in teacher education

The functionality of educational theory in teacher education has been the subject of many discourses and controversies (Wilson, 1975; Isakson & Ellsworth, 1979; Lanier, 1983). It is a well-known fact that, in general, teachers are very sceptical about the value of educational theory. The fact that in discussions among teachers "theory" and "practice" are used as contrasting terms is indicative of this scepticism. One would expect that, especially through the influence of collaborating teachers, this scepticism would carry over into student-teachers' minds. Also in their own teacher training the prospective teachers can find many reasons for doubting the value of educational theory. The following causes can be mentioned:

- Social science incorporates a large number of theories, insights and concepts. These are not always of any importance to teachers.

Nevertheless, authors of textbooks often thoughtlessly suppose that this is the case (Brimer, 1973).

- Often one confines oneself to presenting abstract, theoretical backgrounds. For many students this degenerates to book knowledge, which is to be memorized for the examination.

In the past there have been various sorts of reactions to this gap between theory and practice. At one extreme are those who keep stressing the importance of educational theory and who contend that there is no need for this theory to be directly applicable (McPhie, 1978; Akinpelu, 1975). At the other extreme are those who seem to advocate discarding educational theory altogether and rely fully on everyday practice as the source of educational wisdom (McNamara, 1976).

Less extreme representatives of the "practice first" -orientation often want the prospective teachers to call in the help of educational theory only if they are confronted with insolvable problems in practice. Here the theory is kept in the background until it may be helpful for the solution of problems the student-teacher encounters. Despite the attractive philosophy of this orientation it can be doubted whether this procedure will lead to a systematic body of knowledge on the part of the student-teacher. The kind of and the amount of educational theory that is covered is fully dependent on the casual problems encountered in practical situations.

In this study we start from the following premises: In the first place it is claimed that educational theory is to some degree useful for the prospective teacher and, consequently, should be taught to some degree in teacher education. Secondly, it is claimed that the teaching of educational theory should take place in a systematic way.

To answer the question what exactly is meant by "educational theory" I refer to B.O. Smith's report about prospective teacher training in the United States: "A design for a school of pedagogy" (1980). He distinguishes between "clinical" and "academic" pedagogical knowledge. Clinical knowledge, in his definition, is "what teachers use as they help students, either individually or in groups; it is the verbal counterpart of pedagogical behavior". In other contexts this sort of knowledge is referred to as "craft knowledge". Its main characteristic is its prescriptive value: it gives the teacher rules about how to behave in a particular situation (Smith, 1980, p. 65).

Academic pedagogical knowledge, on the other hand, consists of definitions, principles, facts and values that comprise the content of educational psychology, sociology, etc.

This study is concerned with this "academic pedagogical knowledge". In Smith's opinion its main function lies in the fields of policy making and decision making. In his view it has less utility for direct classroom application because it does not provide teachers with principles that tell "how to attain a given effect" (p. 75). I agree with characterizing academic pedagogical knowledge as non-prescriptive. However, I doubt whether this non-prescriptive nature reduces direct classroom applicability. If we can manage to show the teacher various possible classroom applications (without prescribing a particular one) the teacher would be able to make choices. Confronting the (prospective) teacher with one set of "prescriptions" would be far from ideal. Similar remarks on Smith's ideas have, on a philosophical level, been formulated by Eisele (1982).

The emphasis that has been put on the prescriptive nature of educational theory is linked up with the process-product paradigm that has been prevailing up till recently. During the last few years there has been much debate about the value of this paradigm, the opponents pointing out the lack of consistency between various process-product findings (e.g. Borich, 1979), the proponents pointing out new sophisticated research techniques now in use or new sets of "promising" variables (e.g. "academic engaged time"). In any case, at this moment there are a great many of educational researchers who feel that this process-product paradigm should at least be complemented by an approach which no longer makes teacher behavior the focus of attention. They conceive of the teacher as an information processor and choose their research techniques accordingly. It is noteworthy that many experts in the field of microteaching, which traditionally focuses on changing teacher behavior, have become more and more interested in the cognitive component (Griffiths, 1977) and that cognitive learning models are often used in place of the behavioristic theories to account for the learning that takes place during microteaching (Bierschenk, 1974).

In this study we are concerned with the teachers' thought processes, especially the way in which these thought processes may be influenced. If the focus of attention is on information processing of the teacher, the role of educational theory becomes a different one. Educational theory is no longer

there to give rules for the teacher's behavior, but to enhance his/her "understanding" of what happens in the classroom, enabling him/her to subsequently exhibit (theory-based) behaviors that seem appropriate in that particular situation. In order to make those behaviors possible the pertinent theories should have been "translated" for the teacher up to the level of everyday classroom life.

Some of the above-mentioned notions are present in the protocol materials movement.

Protocol materials; some critical remarks

The Protocol Materials Program focused on the development of film-materials which illustrated key concepts from educational theory, and which enabled the teacher to interpret episodes from everyday classroom life in the light of educational theory. In the seventies, approximately 140 packages of protocol materials were produced, field tested and disseminated.

Because this program is sufficiently well-known I will not pursue that further here. Instead I will make some remarks on a few shortcomings of these materials which have influenced the design of our study. These shortcomings concern the use of educational theory and the way in which the effects of protocol materials were measured.

From the very beginning protocol materials were seen as a means to bridge the gap between theory and practice in teacher education. Smith presented the idea of developing protocol materials because, as he stated, "teachers fail because they have not been trained to analyse new situations against a firm background of relevant theory" (Smith, 1969). This relationship between theory and practice remained in the center of attention (e.g. Grant, 1976). The 11 protocol projects agreed on working on the basis of a "Master Coordinate System", depicting the settings, types of behaviors and age levels for which protocol materials had to be developed (Cruickshank, 1974). Despite the promising starting point, the majority of the protocol materials are not based on coherent educational theories. Instead, most projects focused on more or less isolated concepts, grouped them together and produced protocol films in which a set of the concepts were presented and illustrated (cf. the Inventory of the National Resources and Dissemination Center, 1978). This is even more difficult to understand because after some

time the protocol developers decided to select the concepts first (Orlosky, 1974, p. 295), instead of first filming the behavior and then determining the concepts that would be helpful for the interpretation. It would have been far more obvious then to select those groups of concepts that comprised the central elements of educational theories. The procedure followed led to a continued subdividing into isolated concepts. During the start of the protocol materials program other possibilities were available. I will return to that in the next paragraph.

The second shortcoming, which is both more important and more explicable, concerns the way in which the effects of the protocol treatments (the use of protocol materials) were measured. As we saw from Smith's citation in this paragraph, the rationale for developing protocol materials was that teachers should learn "to analyse new situations against a background of relevant theory". The developers of protocol materials hoped these materials would provide the teachers with a richer conceptual framework, which would enable them to "see" everyday classroom life in a more structured way. References to this claim of the protocol materials are abundant in all literature about protocol materials, e.g. Orlosky, 1974: "Protocol materials should provide examples and behavior that will help the observer acquire the conceptual knowledge necessary to interpret pedagogical events". Without exaggerating one could contend that the main focus of the protocol materials program was to influence directly the teachers' cognitive processes. In evaluating the effects of protocol materials it would have been logically obvious to focus all attention on this cognitive process. If we take a look at the matters that were the actual focus of attention we see that in almost all protocol projects there were reports about the opinions of the users (Cooper, 1975), in most of the projects there were reports about the degree to which teachers, after having worked through the protocol materials, were able to recognize the concepts (e.g. Gliessman & Pugh, 1976) and in some studies the effects on teacher behavior in the classroom were determined (Kluecker, 1974; Borg, 1977). However, I did not find any study in which the most important effect pursued, the effect on teachers' cognitive processes, was investigated. Probably this can be explained from the fact that the majority of the investigations in teacher thinking started after the big protocol materials projects were executed.

The developers of protocol materials can be excused for this as there was hardly a research tradition to associate with.

In the following two paragraphs I will make some remarks pertinent to the solution of the two problems that were discussed here: the choice of educational theories and treatment effects on teacher thinking.

"Models of teaching" as theory translations

If one feels that to bridge the gap between theory and practice in teacher education teachers should be confronted with more or less coherent theories (instead of isolated concepts), immediately the question of which theories should be selected arises. In selecting educational theories two things should be kept in mind: (1) the range of selected theories should be functional for all kinds of educational objectives; especially one should take care not to select only those theories that are functional for attaining cognitive objectives, and (2) the theories should be translated or translatable into everyday classroom behavior.

In our opinion the most successful attempt to translate a great variety of theories that are relevant for educational practice is the "Models of Teaching" approach of Joyce & Weil (1980). They identified 24 educational theories as possibly relevant for daily classroom practice and subsequently "translated" these theories into strategies for teacher behavior. They define a "model of teaching" as "a plan or pattern that can be used to shape curriculums, to design instructional materials, and to guide instruction in the classroom and other settings". They distinguish four "families" of models: information processing models (e.g. Bruner's concept attainment model; Ausubel's advance organizer model), social models (e.g. the role playing model), personal models (e.g. Rogers' nondirective teaching) and behavioral models (e.g. the training model).

The "Models of Teaching" approach was adopted by e.g. Eggen, Kauchak & Harder (1979). The reader who is interested in the philosophy behind the approach or in reports of related research is referred to Joyce, Brown & Peck (1981). In our study we partly draw on the Models of Teaching approach. Particularly we incorporated two of the educational theories in our video treatment materials, with a number of adjustments and modifications.

The reader should be aware of one point which is pertinent to the Models of Teaching approach. Presenting a number of "models of teaching" implies that one has discarded the idea of one "best" teaching strategy. Especially by having at his/her disposal a number of alternatives, it is possible for the teacher to select a strategy which is optimal for a particular situation (in terms of pupil characteristics, available amount of time, goals to be achieved, etc.).

This argument also holds true if one intends to enhance, with the help of the educational theories, the interpretative abilities of teachers, i.e. if one intends to influence their cognitive processes. Focusing on a better perception of what happens in the classroom does not mean that there is an "ideal" way of perceiving (cf. Shavelson 1976 for a related discussion about classroom decision making). The aim is to provide the teachers with instruments with which they can discern elements in everyday classroom life that they did not see before, to provide them with new frames of reference. This sheer enrichment is seen as improvement (cf. Eggleston, 1979, p. 34).

Treatment effects on teacher thinking

Trying to change teachers' cognitions and trying to enhance their interpretative skills poses the problem of how to investigate teacher cognitions. Since the 1974 NIE conference at which recommendations were made for research on teaching as clinical information processing, there has been a strong increase in investigations focused on one or more aspects of teachers' cognitions: teacher planning, teacher judgment, teacher interactive thinking, teacher attributions, teacher implicit theories or teacher decision making. This research has been summarized in Shavelson & Stern (1981) and in Clark & Peterson (in press).

In order to elucidate the choices made in this study it is meaningful to make some remarks concerning the design and the research techniques of most of the investigations that were carried out up to now. Of course I will, in view of this study, concentrate on investigations of teachers' interactive thoughts.

The first notable characteristic is that almost all of them are purely descriptive. The studies are designed to describe as thoroughly as possible

the "naturally occurring" teacher cognitions. In some cases there are comparisons between several groups, for example, between more effective and less effective teachers (Moline & Vallance, 1975). Except for a study by Tuckwell (1980) I know of no investigation in which a treatment was included in the design to purposely change the teacher's cognitions under investigation. This seems strange, in view of the old research maxim that "the best way to get acquainted with a phenomenon is by trying to change it".

Secondly, concerning the subjects used, in the vast majority of studies experienced teachers are used as subjects. For most of the research questions this choice is comprehensible and justifiable. However, when studying experienced teachers' cognitive processes it turns out that the very fact of their being experienced is an impediment for the investigation process. The routinisation that has taken place over the years makes many cognitive processes inaccessible for retrospection or other investigation techniques. Using student-teachers as subjects makes this problem far less prevalent. Besides there are some more practical advantages, e.g. the fact that for student-teachers it is possible to start stimulated recall immediately after the lesson under investigation.

The third general characteristic of the studies of interactive teacher thinking is the fact that very small samples of teachers are used. In the 12 studies summarized by Clark & Peterson, the average number of teachers is 11.4 (If the study by Moline & Vallance is excluded, this figure drops to 9.7). The same holds for the average number of lessons investigated. In this same group of studies, an average of 2.8 lessons per teacher were investigated. (For Shroyer's study it is unclear how many lessons were included in his "mathematics unit"). In view of the very labour-intensive way in which, in general, the interactive thought processes were investigated (stimulated recall), these figures are not surprising. Our present study is no exception to this rule.

The final remarks of the theoretical part of this paper concern the technique that was used in this study: stimulated recall. There has been much debate about the value of retrospection and introspection to obtain valid data about thought processes. Although some discard stimulated recall as a valid

data source (e.g. Nisbett & Wilson, 1977), most authors are moderately to highly positive about its usefulness, provided the proper precautions are taken. The pitfalls and problems that can be mentioned regarding stimulated recall can be summarized into two main points:

- a. The degree to which the teacher has access to his/her own thought process.
- b. The degree to which the researcher influences, by his/her activities before or during the stimulated recall, the retrospection-process of the teacher.

ad. a.:

Generally speaking, retrospection and introspection are problematic techniques when there has been no verbal encoding while the process was in operation, e.g. in perceptual or in perceptual-motor tasks (Ericsson & Simon, 1980). With teachers, the main problem is that much of their behavior has become so automatised that during that behavior they are not aware of any cognitive activity. As Calderhead (1981) states "... the teacher may have long since forgotten the rationality for behaving in such a manner and the behavior may be engaged in unthinkingly". I already referred to the fact that when using student-teachers as subjects this problem is far less predominant. By this I do not intend to say that the experienced teacher's cognitive process is just a routinized version of the student-teacher's cognitive process. Only carefully designed experimental or longitudinal studies can reveal whether other changes besides routinisation take place. For the time being it is, however, likely that also for a number of teacher activities it holds that "with increase in experience with a task, the same process may move from cognitively controlled to automatic status, so that what is available for verbalisation to the novice may be unavailable to the expert" (Ericsson & Simon, 1980).

ad. b.:

The teacher's retrospection process can be directly influenced in two ways. In the first place the investigator can, before starting the stimulated recall, ask a number of specific questions that the teacher has to pay attention to during the stimulated recall. In many studies this procedure was followed. The questions asked were of the following kinds:

- Did you make any decision ?
- Did you notice any disturbance by the pupils ?

In some studies every teacher was asked a standard set of questions of this kind before starting the stimulated recall, in other studies the questions were asked at various moments during the stimulated recall, depending on teacher reactions at that moment. It is clear that in both cases there is an influence on the findings of the stimulated recall data; in the first case it is a systematic one. If the questions asked reflect the main research problem of a study, asking them can be fully warranted. However, the researcher should be aware of the fact that his/her stimulated recall data would differ if other questions had been asked.

A second way to influence the retrospection process can take place if both the teacher and the researcher are allowed to stop the videotape.

Influencing will occur if the researcher selects particular lesson-episodes and asks the teacher to comment on them. After some time the teacher will almost inevitably notice at what type of episodes he/she is supposed to report about the thought process. This will bring about a neglect of other kinds of thought processes or, in the worst case, even post hoc rationalisations. Again, proceeding in this way can be justifiable, but the researcher needs to be fully aware of the possible dangers and to consider his/her data accordingly.

The general conclusion should be that while using a technique still so controversial, containing so many threats to validity that have not yet been fully examined, we should be extremely careful not to induce any unintended effects. In this study this premise has been interpreted as asking as few questions as possible before and giving as few directions as possible during the stimulated recall.

METHOD

This study was part of a larger investigation of teachers' interactive thinking. The larger study concerned 30 student-teachers from two types of teachers colleges, 15 from a teachers college for primary education and 15 from a teachers college for secondary education. Both groups were randomly assigned to 3 conditions, the student-teachers in each condition receiving different kinds of training in educational theory. One group was instructed in two educational theories with the help of written texts and specially designed video materials. The second group received the same training except for the video materials. The third group functioned as a no-treatment group (and followed the normal program in educational theory) to obtain baseline data.

The present study reports the results of the student-teachers from the teachers college for secondary education. The analysis of the data from the students from the teachers college for primary education has not been completed yet. The larger investigation also included measuring a number variables not reported here, mainly concerning additional investigations of student-teachers' cognitive structures after treatment and student-teachers' appreciation of educational theory in general. In the present study we concentrate on the direct influence of the treatment on student-teachers' interactive thinking as reported in their stimulated recall. Its effects on student-teachers' observable teaching behavior will also be reported.

It was hypothesized that student-teachers, having worked through the video materials, would be inclined to use the theoretical key elements in their thinking processes during their own interactive teaching. Moreover, it was hypothesized that for this group the degree to which these key elements were cognitively used would be higher compared to the group which only got a verbal explanation of the educational theories, or compared to the no-treatment group.

Construction of the treatment materials

During the first two years of the project the video treatment materials were constructed. These materials consisted of two 50-minute videotapes, each

tape covering one educational theory. Each videotape is to be seen as a detailed "translation" of the pertinent theory into everyday classroom behavior. As indicated on page 6 we made use of the Models of Teaching approach. In view of the fact that the proper selection criteria are met by a number of theories, selecting two theories for "translation" is rather arbitrary. One cognitively oriented theory (Ausubel's advance organizer model) and one socially oriented theory (Shaftel's role playing model) were selected. This choice has no relationship to the relative value attached to these theories compared to other ones.

Because it is impossible to translate the theories completely into observable classroom behavior, central elements from each theory had to be selected that would be included in the videotapes. In a number of try-out lessons we experimented with translations of the theories. A number of central elements appeared to be "translatable" only in a very ambiguous and unclear way. These elements were excluded from the videotapes. The final list of theory elements consisted of 12 and 8 elements for the advance organizer model and role playing model respectively.

For the advance organizer model these theory elements are:

1. Clarifying the aim of the lesson.
2. Presenting the advance organizer (consisting of a statement at a higher level of abstractness than the learning materials and essentially already familiar to the learners).
3. Clarifying the elements and concepts from the advance organizer.
4. Presenting the new materials, starting with the general ideas and concepts, followed by the specifications (progressive differentiation).
5. Illustrating these differentiations with appropriate schemes.
6. Referring back to the advance organizer.
7. Referring back to the schemes (that illustrated the hierarchical relationships)
8. Giving and repeating precise definitions (by the teacher).
9. Asking the students to summarize the main points of parts of the lesson in their own words.
10. Indicating the similarities and differences between concepts or generalisations at a given level (integrative reconciliation).
11. Asking for additional examples of the concepts or generalisations from the learning material.
12. Indicating the relativity of the learning material by asking the students to recognize assumptions behind the material and to judge and challenge these assumptions.

For the role playing model the theory elements are:

1. Providing the pupils with sufficient details about the problem situation, characters, etc.
2. Promoting identification of the pupils with the story characters.
3. Focusing the pupils on the problem or dilemma to be solved and preventing the pupils from devoting too much energy to details.
4. Pointing to and letting the pupils experience that there are many ways to define a problem, to solve it, to play a role, etc.
5. Concentrating on the thoughts and feelings of the players.
6. Concentrating on the possible personal and societal consequences of the actions and solutions chosen.
7. Comparing the role playing to real life (degree of realism).
8. Summarizing the comments or ideas of a number of pupils.

The procedure for translating the theories into videotapes of classroom behavior was analogous for the two theories. For each of the two theories the procedure consisted of the following phases:

Phase I.

For the construction of the videotape it was necessary to have a great amount of "rough material" at our disposal: lessons in which the theory elements were clearly seen. 6 student-teachers were given detailed instruction in the theory. They read some texts pertaining to this theory and they were asked to prepare a lesson in which the elements of this theory could clearly be seen. Because the video instruments were to be used for student-teachers for both primary and secondary education, subject matter was chosen from the fields of geography, history and physics.

Phase II.

Each student-teacher gave his/her lesson to three complete classes of first year secondary school pupils. The class size ranged from 20 to 25. All lessons were recorded on video, one camera constantly recording the teacher's behavior and two cameras alternately recording the pupils' behavior. The lessons lasted 30 to 50 minutes.

Although experienced teachers might have done the job better, student-teachers were preferred because it was expected that for use at a teachers college an instrument on which student-teachers were the "actors" would be more appealing.

Phase III.

In order to construct the instrument a number of episodes from the lessons had to be selected which were clear illustrations of the educational theory. Because there were three parallel versions of each lesson it was possible

to select the best version of a particular episode. The total number of episodes was sufficient to construct the instrument.

Phase IV.

A video instrument consists of about 50 lesson episodes, pertaining to the theory elements. The instrument consists of 3 parts. At first each theory element is presented in a rather "pure" example and the student-teacher is asked to classify the behavior. Later on more complex and "embedded" examples are used. After each episode a question is asked (both audible and visible on the screen). The students record their answers and the videotape goes on. In the first two parts of the tape there is immediate feedback, in the last part the feedback occurs at the end.

Phase V.

The videotape was revised on the basis of reliability and feasibility data obtained from 220 student-teachers.

The videotapes can be used in all cases where the pertinent theories have been explained and discussed. They can be used to determine to what degree a student-teacher is able to interpret a real-life classroom situation in terms of his/her theoretical knowledge. In teacher training the instruments can serve both didactic and evaluative purposes. This study concentrates on the effects of these instruments on student-teachers' interactive thoughts and behaviors.

Besides the video instruments, two 14-page texts were produced in which the two theories were summarized and explained. Every time a reference was made to one of the theory elements, the number of that element was indicated in the margin. At the end of the text the theory elements were once again summarized.

Design and sample

The sample consisted of 6 female and 9 male student-teachers in the last year of their teacher training. The size of the sample had to be limited because of the time-consuming measures that were planned to be done (stimulated recall). The proportions of males and females reflect the proportions in the total population. (In the larger investigation, including the student-teachers from the teachers college for primary education, there were 13 males and 17 females).

The 15 student-teachers were randomly assigned to 3 conditions:

- I. These student-teachers were instructed in two educational theories (the advance organizer model and the role playing model), including the two texts, and worked through the video materials.
- II. These student-teachers were instructed in the two educational theories, including the two texts. They spent the same amount of time on the two theories as group I.
- III. These student-teachers formed the no-treatment group and followed the normal program in educational theory.

About one month after the treatment all student-teachers gave two lessons at their own probationary schools. The lessons were recorded on video; subsequently the student-teachers' interactive thought processes were investigated by means of stimulated recall.

Procedure

The two educational theories were taught at the teachers college by the student-teachers' own teacher educators. For each theory the student-teachers studied the written text at home. At the teachers college the theory was further explained and discussed. The theory group students (group II) subsequently got many types of assignments relating to the theory. For example, for the advance organizer model an assignment could be: "If you were to give a lesson about subject X to a group of 14-years old pupils with no specific knowledge of the subject, what kind of advance organizer would be appropriate?".

The video/theory group students (group I) worked through the video materials, answering the questions on their sheets and discussing theory elements that were unclear. Care was taken that the two groups spent the same total amount of time working on the theories.

The control group students (group III) got no special treatment and continued with the normal educational theory program.

One month after the instruction in the two educational theories the students were asked to give two lessons at their own probationary schools. These were the schools where the student-teachers had worked during the previous few months (for one day each week). They knew the pupils in the classes where the lessons were given.

Students from group I and II were asked to give two lessons, a lecture lesson and a role playing lesson, in which they used the knowledge about lecture lessons and role playing lessons they had acquired one month before. Students from group III were asked to give a lecture lesson and a role playing lesson. No specific assignments were given concerning choice of subject. Restriction to one subject would, in our opinion, have produced the danger of finding artifacts in the stimulated recall data: effects that are caused only by the choice of that specific subject. Especially with student-teachers it can be expected that if a lesson about a specific topic is to be given, they will get their information, at least in part, from the same sources, which can have drastic consequences for the content and structuring of the lesson (and the related thought processes). In the preparation of the lessons the students were free to use any materials they found appropriate. There were no instructions concerning the amount of time to be spent on lesson planning. A written lesson plan was made for each lesson. The student-teachers made all the arrangements with the probationary schools themselves. They were told that the lessons would be recorded on video and that after the lesson there would be an extensive discussion of the lesson. They were asked to arrange for a quiet room at the probationary school in which this "discussion" could take place without disturbance.

The lessons were given to complete classes of 14 year old secondary school pupils. The pupils were not informed beforehand about the topic to be treated or the fact that video recording would take place. The lessons lasted about 40 minutes. Recording took place with one camera from the back corner of the classroom. The camera continuously focused on the teacher, except during the actual role playing scenes, when it focused on the pupils playing. In a pilot study we had tried to focus on those pupils to which the attention of the teacher was directed at a particular moment. This appeared to be very difficult. Moreover, it turned out that the focus of the camera influenced the content of interactive thoughts the teachers reported during stimulated recall. So it was decided that in the main study the camera would continually focus on the teacher.

Because every student-teacher had to be visited at his/her own probationary school, it was not possible to investigate more than one lesson per day. On the average there was a two week interval between the two lessons. Half of the student-teachers started with the lecture lessons and half with the role playing lessons in order to control for "learning" effects concerning the proficiency in stimulated recall.

After giving the lesson, the student-teacher took a short pause. Stimulated recall always started within one hour after termination of the lesson. In a pilot study we experimented with a procedure which was discarded in the main study. It allowed the student-teacher to see the entire videotape beforehand, in order to get him/her accustomed to seeing him/herself on videotape. It appeared, however, that student-teachers who had seen their lessons beforehand were, compared to student-teachers who had not seen the tape, inclined to express during stimulated recall all kinds of rationalisations at those parts of the lessons where "things went wrong". Probably this tendency is relatively strong with student-teachers, compared to experienced teachers. Student-teachers are accustomed to having their lessons evaluated by others, and probably they are inclined to look at their own lessons "through the eyes" of an outsider. Having already seen the lesson one time in such a way may influence subsequent stimulated recall. It was decided not to follow this procedure in the main investigation. It also led us to emphasize more explicitly during the instruction for the stimulated recall the non-evaluative stance of this investigation, thereby assuring that no information about either the lesson or the stimulated recall data would be reported to the teachers college.

At page 10 it was discussed why it is advisable to make the instruction for the stimulated recall not too specific. The literal instruction in this study was as follows:

We will now look at the lesson you just gave. The purpose of our viewing the lesson is that you should try to remember what went "through your head" while you were teaching. Of course, during a 50 minute lesson there are lots of things that go "through your head". Without aids it would be impossible to remember. Our hope is that viewing the videotape of your lesson will help you to remember more of what you thought during your lesson. When looking at the videotape try to "relive", to experience again what happened during the lesson. Stop the videotape at every moment

you remember something that went "through your head". Try to say anything you remember about it, without wondering whether this is important enough to say, or something like that. However, what you say should bear upon the things you thought during the lesson. It should not concern things that you contrive now, while looking at the videotape, or things that strike you right now. Please stop the videotape (indicate how) every time you remember something that went through your head while teaching. Start the tape again (indicate how) when you have said what you wanted to say. Sometimes students get so absorbed in looking at their own lesson that they seem to have forgotten this instruction. If that is the case (and you let the tape run for more than 45 seconds without saying something) I will stop the tape and ask you what you thought at that moment of the lesson. If you cannot remember what you thought at that moment you can say that and start the tape again. But, in general, I will not interfere. You are the one giving the information. I only listen and write something occasionally. Perhaps I will ask some short questions.

As you will understand right now, it is absolutely unimportant whether this was a good lesson or not, whether there was a fine atmosphere or not, etc. For this investigation, which is concerned with what went through your head while teaching, this is completely out of order. I am not interested in any kind of evaluation of this lesson.

Anything you say will be dealt with confidentially. Neither your cooperating teacher at this school nor your teacher trainer will be informed about it. Any questions? You can start the tape.

From the instructions it appears that the only situation in which the investigator is allowed to stop the videotape is when the student-teacher waits too long a time before reporting about his/her cognitive process. The tape is never stopped by the investigator at particular or potentially interesting lesson episodes. The types of questions the investigator is allowed to ask are restricted to three types:

1. Literal repetitions or paraphrasings of the opening question ("What did you think?"). This question is asked when the investigator stops the tape because the student-teacher lets too much time pass before reporting.
2. Inquiries about whether the teacher utterance is interactive or not ("Is this something you thought during the lesson or did you notice this right now?"). This question is asked in all cases where the investigator is uncertain about the character of the teacher utterance, the information the student-teacher gives being insufficient to decide whether the utterance is interactive or not.
3. Short encouragements ("I understand", "OK").

The stimulated recall interview was audiotaped. After 45 minutes the student-teacher was asked whether he/she needed a break. After the stimulated recall additional measures were taken (not reported here).

Analysis

The analysis reported in this paper concerns the data about the student-teachers' interactive thoughts (recorded on audiotape during stimulated recall) and behavioral data (recorded on videotapes of the lessons). For both theories, category systems were devised, one to analyse the stimulated recall data and one to analyse the behavioral data. The general identification of the categories was relatively simple: The category systems intended to analyse the stimulated recall data and behavioral data of the lecture lessons reflected the 12 key elements of the advance organizer model, the category systems intended to analyse the stimulated recall data and behavioral data of the role playing lessons reflected the 8 key elements of the role playing model. Behavioral data were analysed directly from videotape, the stimulated recall data were first copied out literally. A great deal of time was spent on repeated revision of the category systems, mainly on the basis of reliability data of each version. The final intercoder reliability was .83, .86, .85 and .87 for the behavioral and stimulated recall data of the lecture lessons and the behavioral and stimulated recall data of the role playing lessons respectively. In the final category systems, each category incorporates a number of decision rules on the bases of which dubious cases can be coded. To decide whether a teacher utterance was to be interpreted as being interactive or not, the rules employed by Marland (1977) were used, be it with some modifications. All final codings of behavioral and stimulated recall data were done by a coder who did not know to what experimental groups the student-teachers belonged.

On theoretical grounds a difference in cognitive use of theory elements was expected between the experimental groups. It could also be expected that for student-teachers of group I (video/theory) their behavioral use of theory elements would be relatively more frequently accompanied by an "appropriate" interactive thought, i.e. an interactive thought pertaining to the same theory element. So in the analysis it was meaningful to check what proportion of theory related teacher behavior was accompanied by the "appropriate" thought. In the analysis it turned out that it was very difficult to decide what was to be seen as "accompanied by". The relationship between teacher behavior (as shown on videotape) and teacher thinking (as reported during stimulated recall) can take various forms. In some cases

the student-teacher, while viewing the videotape, anticipates his/her behavior ("Here I decided to summarize the main points and..."), resulting in a coding of the interactive thought element before the behavioral one. In other cases viewing his/her behavior on video reminds him/her of the thought during that behavior in the lesson ("Here I thought..."), resulting in coding of the interactive thought element coinciding with the behavioral one. There are also cases where the thought element must be coded after the behavioral one. In deciding on the existence of a relationship between behavioral and thought elements it was supposed that a specific behavioral theory element was "accompanied by" a related theory element in interactive thinking if the teacher reported about thinking of that same theory element in the time range 30 seconds before to 30 seconds after the actual exposing of that behavior. This 60 second interval is rather arbitrary. There are, however, no theoretical considerations on which decisions can be based. Besides, this arbitrariness applies to all 3 experimental conditions. It appeared that using 120 second or 40 second intervals influenced the absolute number of cases found, but did not influence the ratios between the average scores of the 3 experimental groups.

The statistical analysis will take place after the stimulated recall data of all 30 student-teachers have been coded. At the moment only the differences between the 3 experimental groups have been tested by t-tests, specified for the various theory elements.

Results

The average number of teacher utterances during stimulated recall was 161. There were no differences in the 3 averages between the experimental groups: 157 for the video/theory group, 159 for the theory group and 166 for the control group.

For all three groups the percentage of non-interactive teacher utterances was small: 5 % for the video/theory group, 5 % for the theory group and 3 % for the control group.

The average percentage of theory related utterances was 26 % for the video/theory group, 14 % for the theory group and 7 % for the control group.

The average number of remarks by the investigator during stimulated recall was extremely low: 2.4 times per lesson, 60 % of these remarks being paraphrasings of "What did you think", 32 % questions about whether the thought reported was interactive or not and the rest being encouragements.

The main hypothesis was that for student-teachers, having worked through the video materials ("video/theory"), the degree to which theory elements would be used would be higher compared to a group which only got verbal explanations ("theory") or to a control group ("control").

Table 1 summarizes the average number of theory related thoughts expressed by the video/theory and the theory group during the stimulated recall of the lecture lesson, specified for the 12 theory elements.

Table 1

(For the meaning of the 12 theory elements see page 12).

It shows that for 10 of the 12 theory elements there is a difference in the hypothesized direction, for one element there is no difference and for one element there is a difference in the non-hypothesized direction. For one third of the theory elements the difference is statistically significant. Table 2 presents the same data for the video/theory and the control group. Here all differences appear to be in the hypothesized direction, being significant in half of the cases.

Table 2

The stimulated recall data presented in Table 1 and 2 are summarized in Figure 1. Here it can be seen that the general tendency of the 3 experimental groups is in the hypothesized direction.

Figure 1

The study also investigated the effects of the experimental treatments on the behavior of student-teachers, exhibited during the lessons. In general it appeared that the effects of the experimental treatments on teacher behavior were smaller than the effects on interactive thinking.

Table 3 and 4 are analogous to Table 1 and 2. They summarize the average number of theory related behaviors exhibited during the lecture lessons, specified for the 12 theory elements. Table 3 compares the video/theory group with the theory group, Table 4 compares the video/theory group with the control group. Figure 2 summarizes the two tables.

Table 3

Table 4

Figure 2

In Table 3 there are 10 differences in the hypothesized direction, in Table 4, 11 differences. However, the differences are relatively small and, compared with the differences between the interactive thoughts of groups, fewer of them are significant.

The same comparisons that were made on the data of the lecture lessons were also made on the data of the role playing lessons. In Table 5 the average number of theory related thoughts expressed by the video/theory and the theory groups during the stimulated recall of the role playing lessons are presented. 1 of the 8 differences appears to be in the non-hypothesized direction; 3 differences appear to be significant.

Table 5

(For the meaning of the 8 theory elements see page 13).

As expected the differences between the video/theory and the control group are larger. They are presented in Table 6.

Table 6

Figure 3 summarizes the stimulated recall data of the role playing lesson.

Figure 3

Also for the role playing lessons, the behaviors of student-teachers during teaching were compared. The behavioral data for the role playing lessons of the 3 experimental groups are, analogously to the behavioral data of the lecture lessons, presented in Table 7 and 8 and in Figure 4.

Table 7

Table 8

Figure 4

As indicated at page 20 it was investigated to what degree teachers' theory related behaviors during interactive teaching had an "appropriate" counterpart in their thought processes, i.e. to what degree exhibition of behavior in which a particular theory element could be discerned was accompanied by the same theory element in their thought process (as reported during stimulated recall) at the same moment. Figure 5 presents (for the three experimental groups) the proportions of theory related teacher behavior which were accompanied in time by the "appropriate" (matching) interactive thinking, specified for the 12 theory elements of the lecture lessons. Figure 6 does the same for the role playing lessons.

Figure 5

Figure 6

It appears that, in general, the proportion is highest for the video/theory group, followed by the theory group, while the proportion is lowest for the control group. These data suggest that the teaching of educational theories with the help of these video materials not only induces the student-teachers to use the theory elements (both cognitively and in their interactive behavior) more frequently, but it also induces them to use these elements more consciously, with a higher degree of awareness of what one is doing.

DISCUSSION

When considering the results of this study it is important to keep in mind the specific nature of both the treatment and the effects measured. In contrast to most of the studies done up to now, the measuring of teachers' interactive thoughts does not concern teaching "in general", but specific forms of teaching: lecture lessons and role playing lessons. The training concerned two specific educational theories, the elements of which are especially useful for the two forms of teaching mentioned. Although the theory related thoughts and behaviors measured in this study can also be found in "naturally occurring" situations (cf. the data of the control group), it is not surprising that training in the educational theories produces substantial effects (compared to the control group). The differences between the video/theory and the theory group are far more interesting, as the specificity of the training was the same for both groups; the same holds for the time spent studying the two theories.

As in other investigations of teacher interactive thoughts, the size of the sample is rather small in this study. For that reason it seems better to postpone drawing conclusions concerning the single theory elements until the data of all 30 student-teachers have been analysed. On the basis of the present data it seems possible, however, to draw some general conclusions. When considering the data of Tables 1, 2, 5, 6 and Figures 1 and 2, the general tendency is clear: in general, video/theory treatment produces the highest cognitive use of educational theories, the theory treatment the second highest, while the control group has the lowest results. The same holds, although less prominent, for the effects on interactive teacher behavior (see Tables 3, 4, 7 and 8 and Figures 3 and 4). The fact that the effects on interactive teaching behavior are less prominent is explicable from the type of treatment. The treatment did not focus on behavioral changes but, in line with the original ideas of the protocol materials movement, tried to change teachers' cognitions.

The fact that most of the differences between the experimental groups are in the hypothesized direction gives good hope for finding more significant differences when the data of all student-teachers have been analysed.

In this study the student-teachers from the video/theory and the theory group were explicitly asked to use their knowledge about the educational theories in their lessons. In designing this study other possibilities were considered. However, leaving it to the student-teachers' own initiative to use the theories or not would produce several distortions in the data: most of the student-teachers would perhaps infer that they were supposed to use the two theories (that were taught one month before at the teachers college) in their lessons, some would perhaps not draw this inference. So it was decided to ask all students to deliberately try to use the theories. For this reason the differences with the no-treatment group will no doubt be partially artificial. However, this effect is the same for the video/theory and the theory group. So the differences between these two groups cannot be produced by it.

Comparisons between the experimental groups took place by counting the number of times each theory element occurred (in behavioral or stimulated recall data) and computing the averages. Such a procedure of counting the number of times each theory element occurs is not without problems. In fact, it assumes that all occurrences of theory elements are comparable, allowing one to add the total amount for every student-teacher. When averages of a group of student-teachers are computed, this procedure can lead to "compensating" of one student-teacher for another. In a hypothetical situation two teachers who each use a particular theory element 3 times will get the same average as two teachers of which one uses the theory element 6 times and the other does not use it at all.

There is no clear-cut solution to this problem. It could be argued that it is far more important to know whether a teacher has used a theory element at least one time or not at all than to know the exact number of times he/she used it. In the final analysis several possibilities will be checked. For this study we traced how many teachers in each group used each theory element at least once in their interactive thought processes.

The results are presented in Figures 7 and 8, for the lecture lesson and the role playing lesson respectively.

Figure 7

Figure 8

It appears that the general tendency does not differ from the general tendency found on the basis of the "counting procedure". This does not however set aside the rather arbitrary character of the counting procedure.

If one considers teacher thinking an important determinant of the events in the classroom, it is obvious that influencing this thinking process can be worthwhile. It seems the more worthwhile if these cognitions can be changed to incorporate key elements of useful educational theories. This study investigated some conditions under which this may or may not take place. Results suggested that teachers are more readily influenced under video/theory conditions. If the results of the larger investigation are consistent with these findings, this information can be helpful for teacher education. In that case it would be reasonable to develop more instruments of the same kind (pertaining to other educational theories), so that these instruments may partly take over the role of traditional, purely verbal, transmission of educational theory.

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Table 1

Means of video/theory group and theory group on the variable "number of theory elements expressed during stimulated recall" (lecture lesson)

theory element	mean video/theory	mean theory	difference
1	1.4	1.2	+ 0.2
2	1.8	1.0	+ 0.8
3	3.0	0.4	+ 2.6 **
4	7.2	4.2	+ 3.0 *
5	4.0	4.8	- 0.8
6	2.6	2.0	+ 0.6
7	5.0	1.4	+ 3.6 *
8	5.0	3.0	+ 2.0
9	2.4	2.4	0
10	3.8	2.8	+ 1.0
11	9.0	1.4	+ 7.6 *
12	1.6	0.4	+ 1.2

* significant at .05 level

** significant at .01 level

For the meaning of the theory elements see page 12

Table 2

Means of video/theory group and control group on the variable "number of theory elements expressed during stimulated recall" (lecture lesson)

theory element	mean video/theory	mean control	difference
1	1.4	0.6	+ 0.8
2	1.8	0	+ 1.8 *
3	3.0	0	+ 3.0 *
4	7.2	5.4	+ 1.8
5	4.0	2.4	+ 1.6
6	2.6	0	+ 2.6 **
7	5.0	0	+ 5.0 *
8	5.0	0.8	+ 4.2 *
9	2.4	0	+ 2.4 *
10	3.8	2.8	+ 1.0
11	9.0	1.0	+ 8.0 *
12	1.6	0	+ 1.6

* significant at .05 level

** significant at .01 level

For the meaning of the theory elements see page 12

Table 3

Means of video/theory group and theory group on the variable "number of theory elements exhibited during lesson" (lecture lesson).

theory element	mean video/theory	mean theory	difference
1	1.0	0.6	+ 0.4
2	0.8	0.4	+ 0.4
3	1.4	0.2	+ 1.2 *
4	7.2	6.8	+ 0.4
5	7.2	6.4	+ 0.8
6	2.2	1.0	+ 1.2
7	6.8	3.6	+ 3.2
8	1.6	2.2	- 0.6
9	2.4	1.8	+ 0.8
10	3.0	2.0	+ 1.0 *
11	4.4	2.4	+ 2.0
12	0.2	0.6	- 0.4

* significant at .05 level

** significant at .01 level

For the meaning of the theory elements see page 12

Table 4

Means of video/theory group and control group on the variable "number of theory elements exhibited during lesson" (lecture lesson)

theory element	mean video/theory	mean control	difference
1	1.0	1.0	0
2	0.8	0	+ 0.8
3	1.4	0	+ 1.4 *
4	7.2	8.8	- 1.6
5	7.2	6.4	+ 0.8
6	2.2	0	+ 2.2 *
7	6.8	0.2	+ 6.6 *
8	1.6	1.4	+ 0.2
9	2.4	0	+ 2.4 **
10	3.0	1.2	+ 1.8
11	4.4	1.0	+ 3.4 *
12	0.2	0	+ 0.2

* significant at .05 level

** significant at .01 level

For the meaning of the theory elements see page 12

Table 5

Means of video/theory group and theory group on the variable "number of theory elements expressed during stimulated recall" (role playing lesson)

theory element	mean video/theory	mean theory	difference
1	14.8	9.8	+ 5.0 *
2	5.0	4.0	+ 1.0
3	5.8	4.6	+ 1.2
4	7.6	8.4	- 0.8
5	4.4	0	+ 4.4 *
6	0.8	0	+ 0.8
7	5.6	2.8	+ 2.8
8	8.6	3.6	+ 5.0 *

* significant at .05 level

For the meaning of the theory elements see page 13

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Table 6

Means of video/theory group and control group on the variable "number of theory elements expressed during stimulated recall" (role playing lesson)

theory element	mean video/theory	mean theory	difference
1	14.8	5.4	+ 9.4 **
2	5.0	2.2	+ 2.8 *
3	5.8	1.4	+ 4.4 *
4	7.6	0.8	+ 6.8 *
5	4.4	0.4	+ 4.0 *
6	0.8	1.0	- 0.2
7	5.6	2.4	+ 3.2
8	8.6	0.2	+ 8.4 **

* significant at .05 level

** significant at .01 level

For the meaning of the theory elements see page 13

Table 7

Means of video/theory group and theory group on the variable "number of theory elements exhibited during the lesson" (role playing lesson)

theory element	mean video/theory	mean theory	difference
1	6.2	7.2	- 0.8
2	4.2	2.8	+ 1.4 *
3	1.6	1.0	+ 0.6
4	6.8	4.6	+ 2.2
5	2.8	1.8	+ 1.0
6	0.6	0.4	+ 0.2
7	3.4	2.8	+ 0.6
8	3.4	1.2	+ 2.2 *

* significant at .05 level

For the meaning of the theory elements see page 13

Table 8

Means of video/theory group and control group on the variable "number of theory elements exhibited during lesson" (role playing lesson)

theory element	mean video/theory	mean control	difference
1	6.2	3.6	+ 2.6 **
2	4.2	1.6	+ 2.6 *
3	1.6	0.4	+ 1.2
4	6.8	1.2	+ 5.6 **
5	2.8	0	+ 2.8
6	0.6	0.2	+ 0.4
7	3.2	1.2	+ 3.2
8	3.4	0	+ 3.4 *

* significant at .05 level

** significant at .01 level

For the meaning of the theory elements see page 13

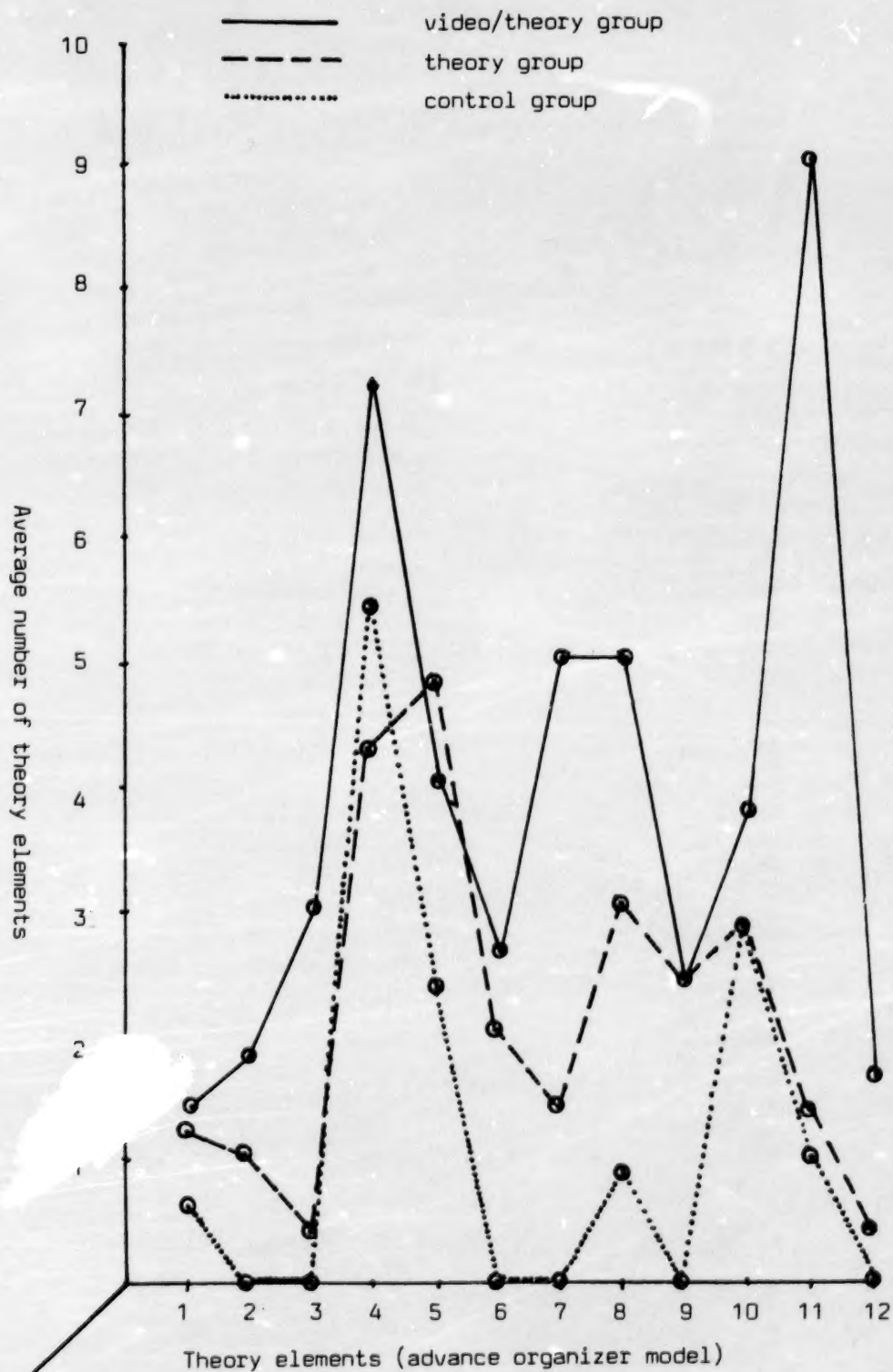


Figure 1.

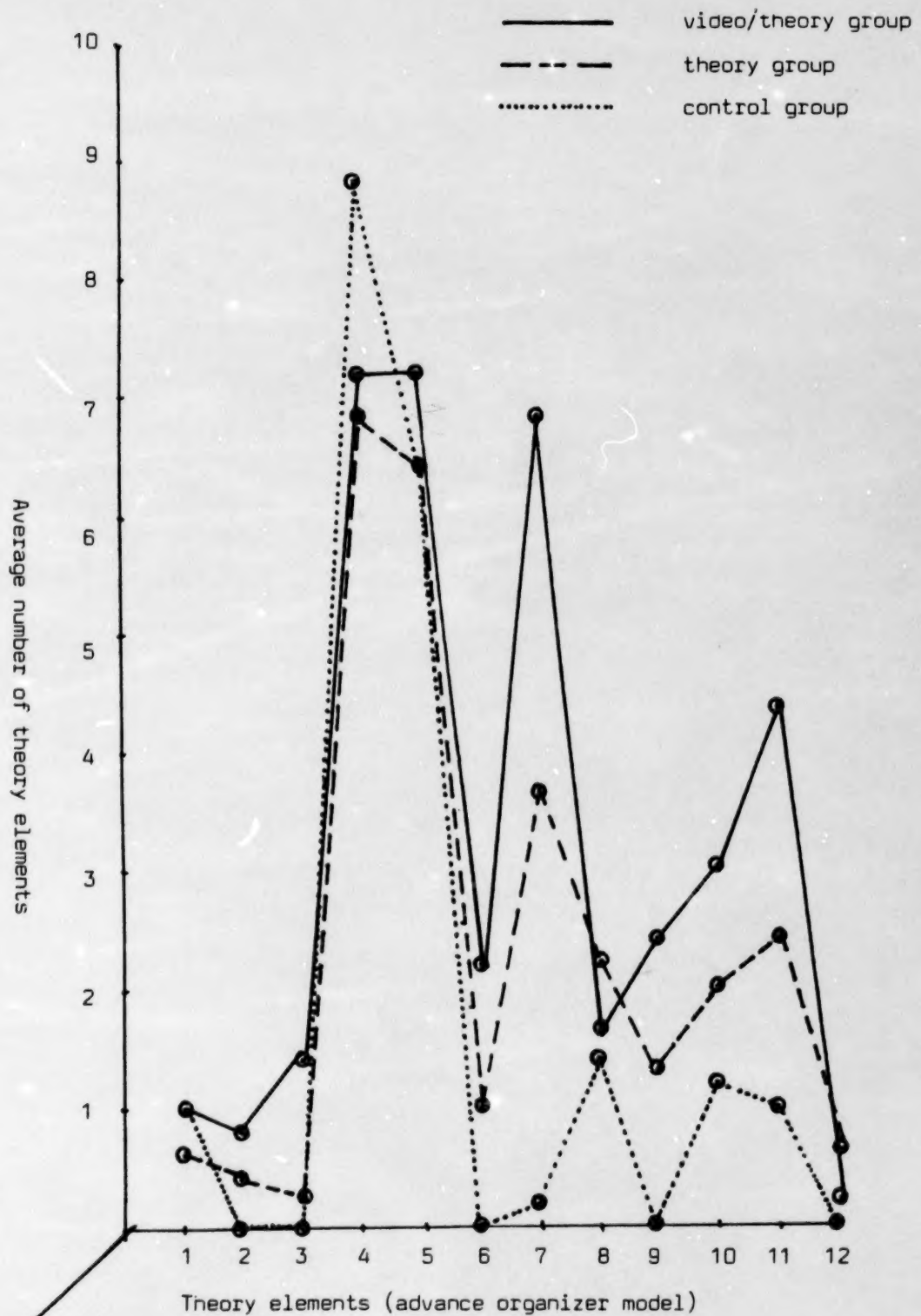
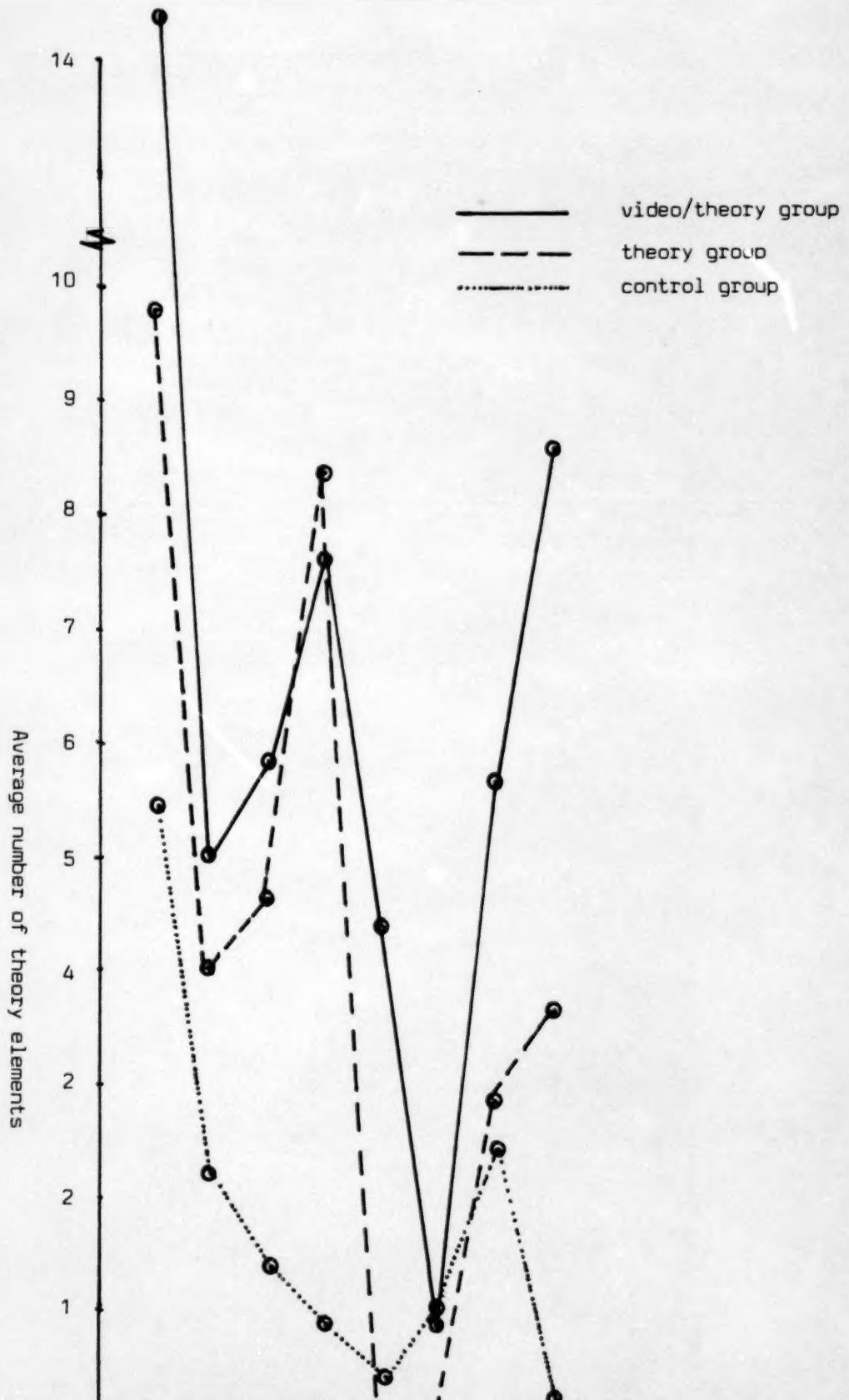


Figure 2.

Average number of theory elements exhibited during lesson

Figure 3

Average number of theory elements expressed during stimulated recall
(role playing lesson)



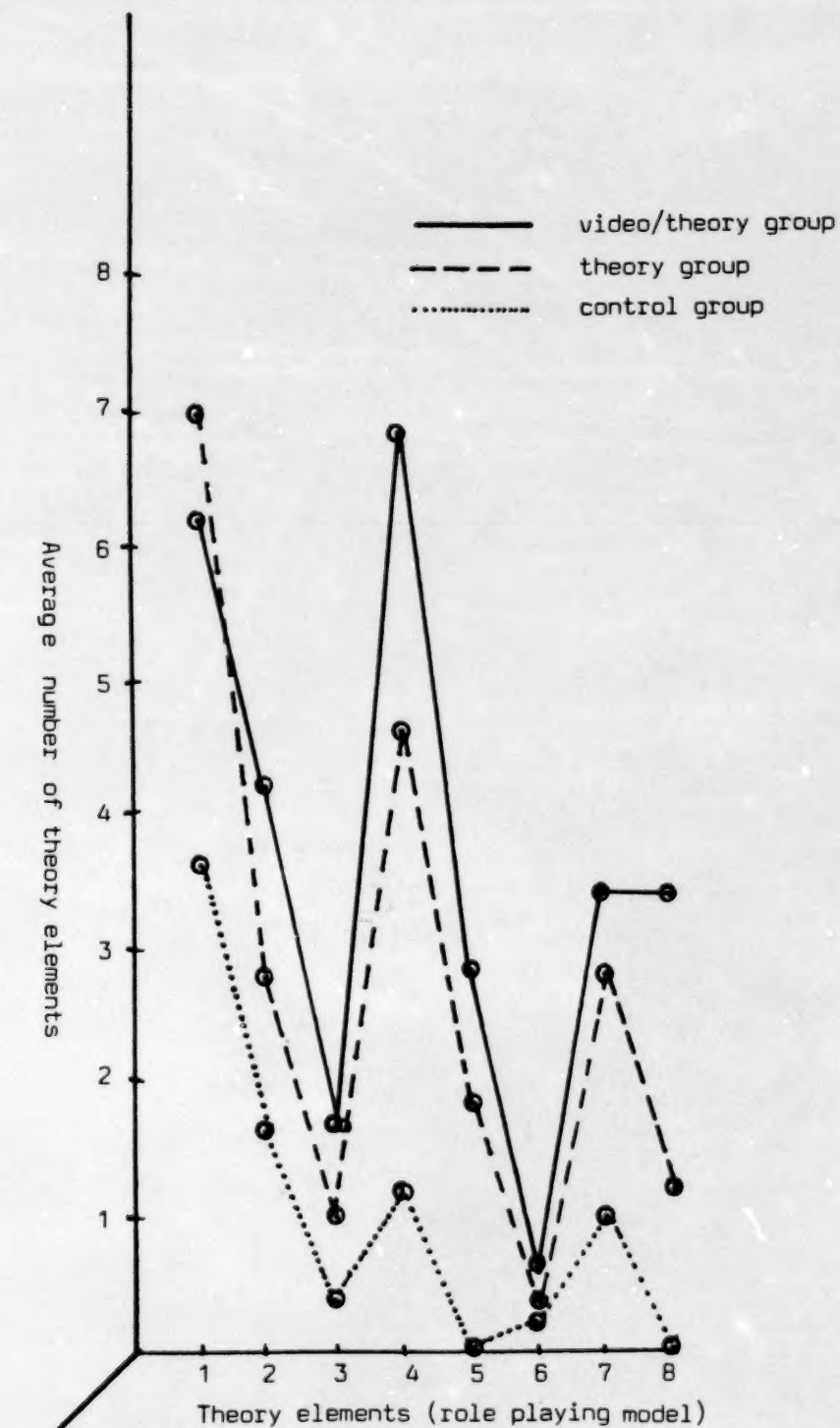


Figure 4.

Average number of theory elements exhibited during lesson
(role playing lesson)

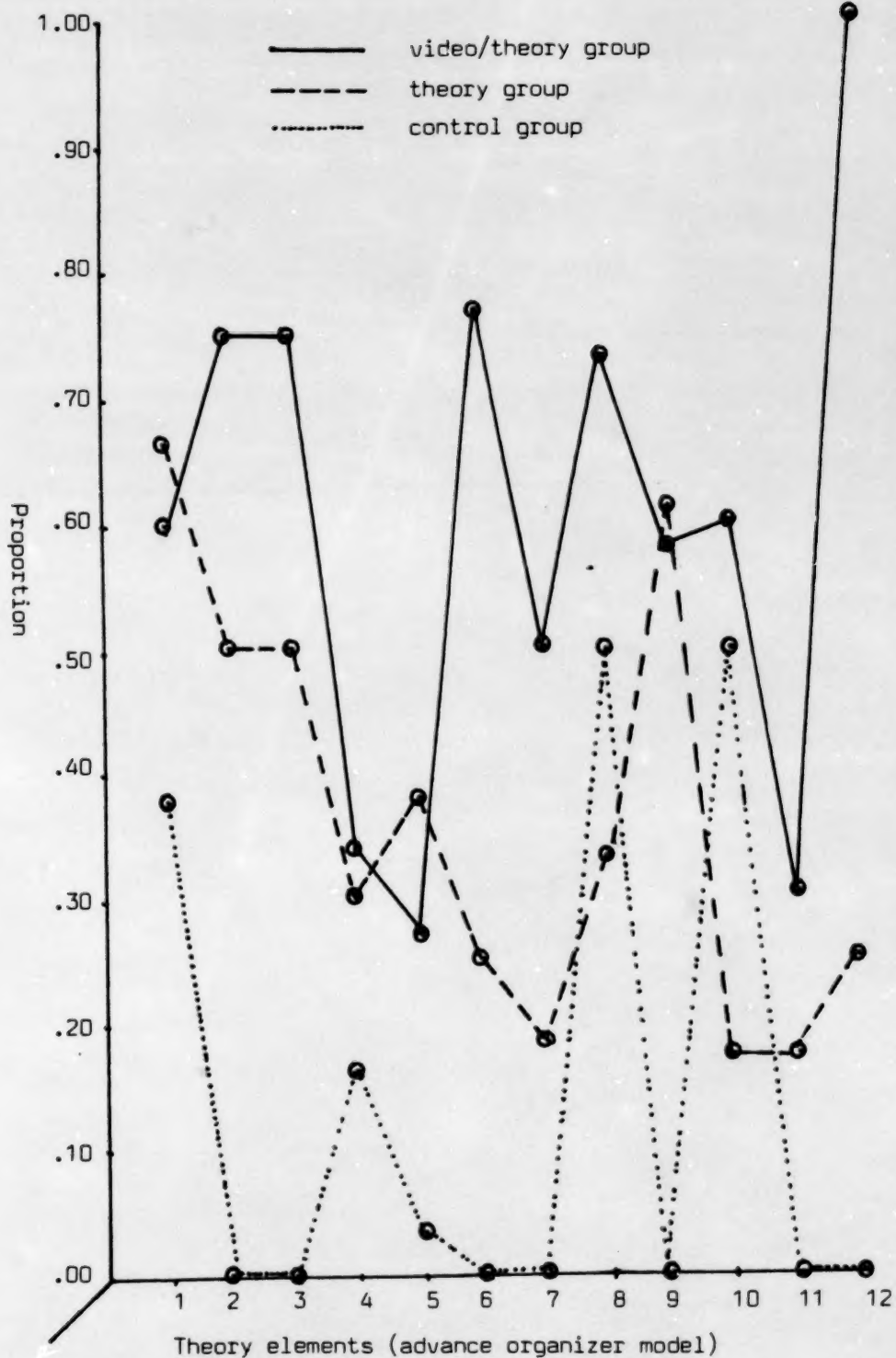


Figure 5.

Proportion of theory related behavior accompanied by "matching" interactive thoughts. (lecture lesson)

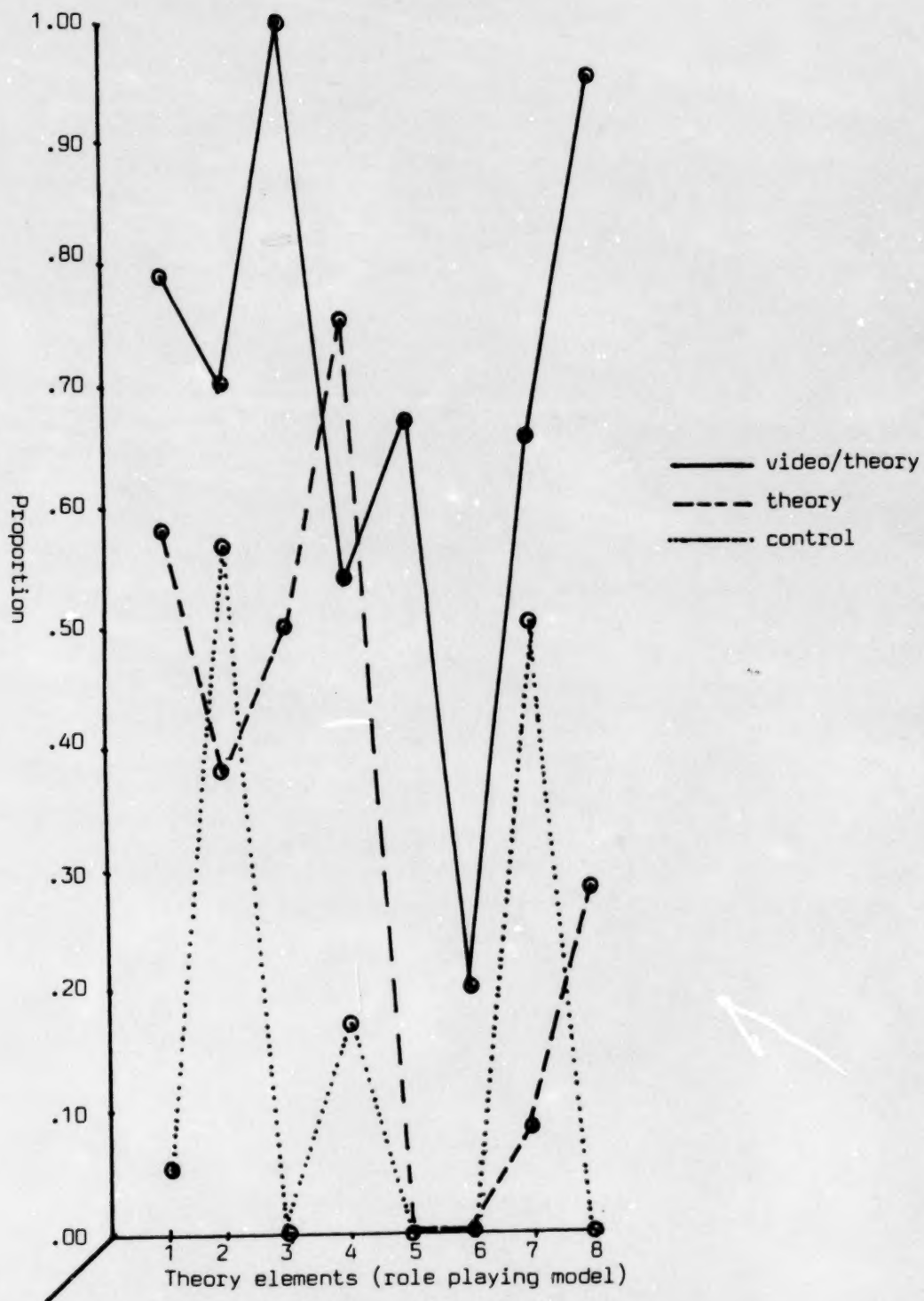


Figure 6.

Proportion of theory related behavior accompanied by "matching" interactive thoughts. (role playing lesson)

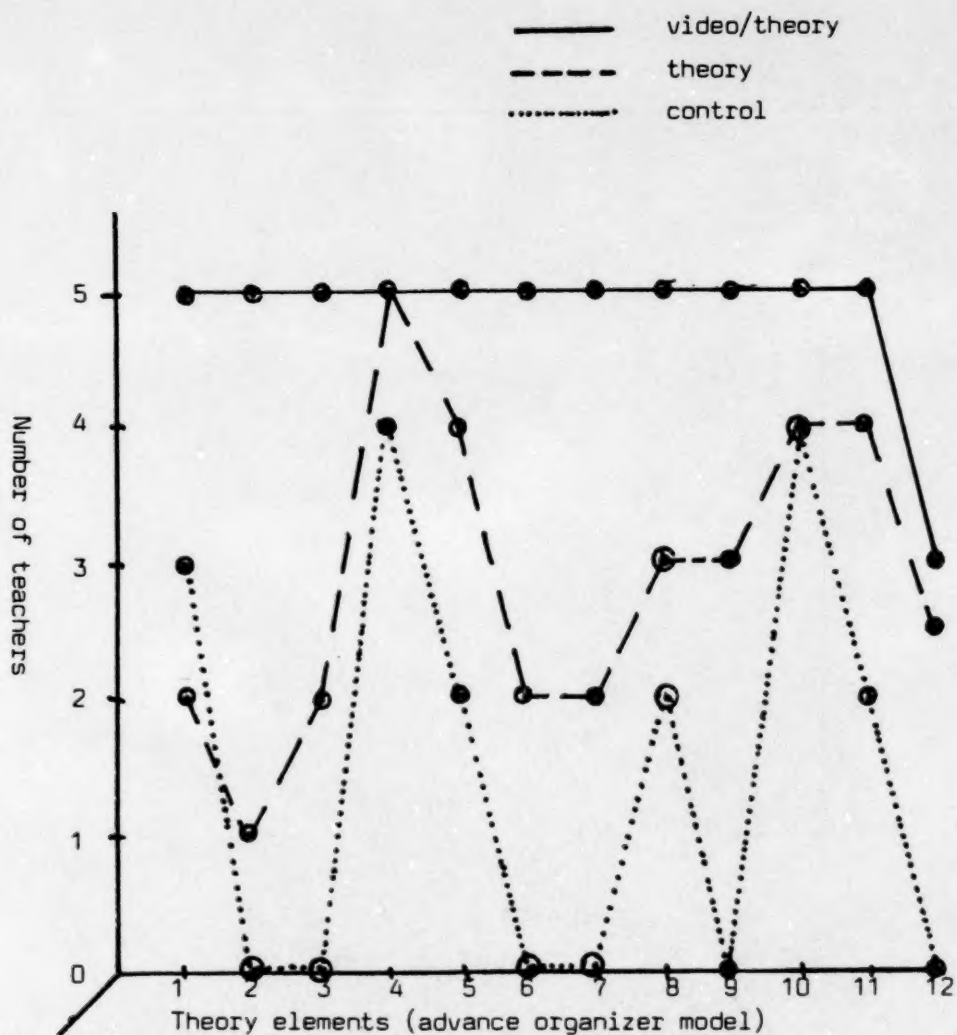


Figure 7.

Number of teachers using the theory elements at least once in interactive thinking (lecture lesson)

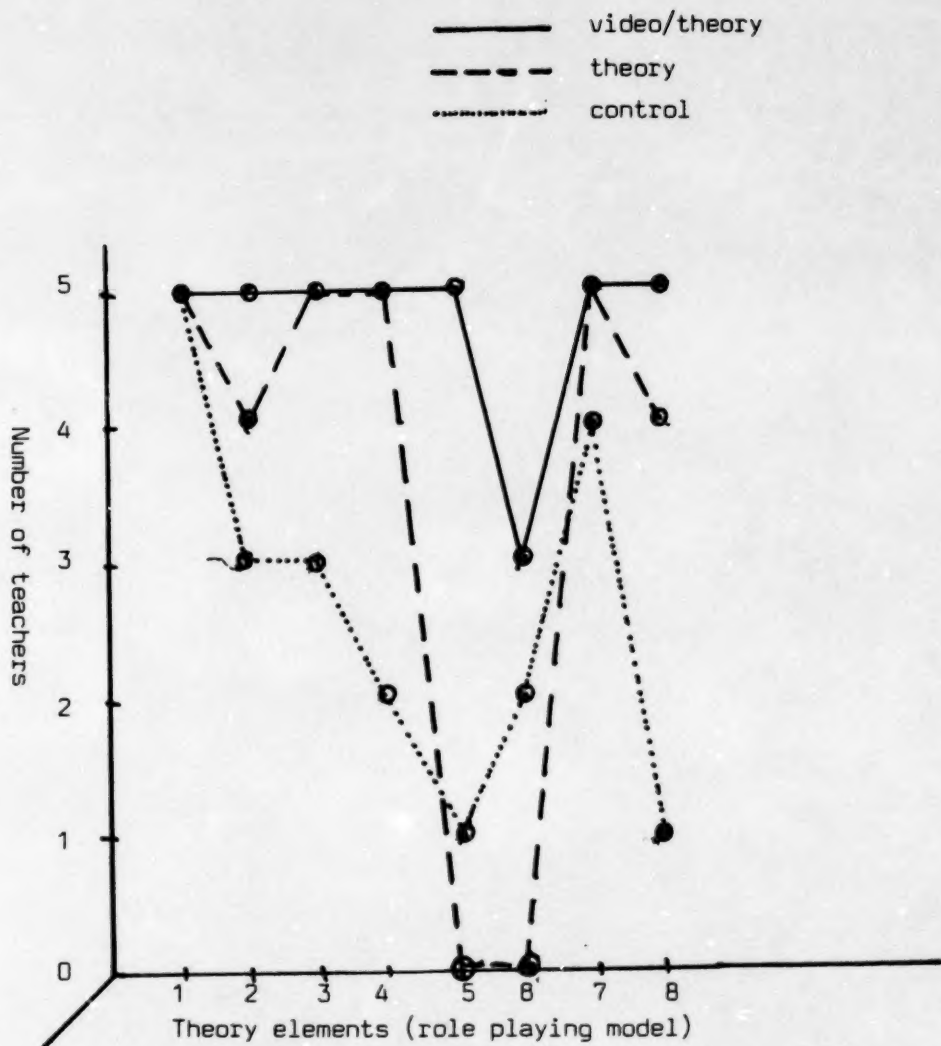


Figure 8.

Number of teachers using the theory elements at least once in interactive thinking (role playing lesson)